BC hydro

Technical Report

Proposed Circuit 2L39 and 2L40 Underground Cable Replacement between Newell Substation and Hill Avenue Terminal Station

March 2000

THE POWER IS YOURS

BC hydro

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BC hydro

Proposed Circuit 2L39 and 2L40 Underground Cable Replacement between Newell Substation and Hill Avenue Terminal Station

Technical Report

March 2000

PROPOSED CIRCUIT 2L39 AND 2L40 UNDERGROUND CABLE REPLACEMENT BETWEEN NEWELL SUBSTATION AND HILL TERMINAL STATION TECHNICAL REPORT

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SECTION A – PROJECT SCOPE

The scope of the proposed Circuit 2L39 and 2L40 underground cable replacement project between Newell Substation and Hill Avenue Terminal Station consists generally of the following:

- Upgrading of access to the Hill Avenue Terminal Station.
- Relocation of the Hill Avenue Terminal Station to a new location immediately east of the existing station.
- Replacement of the deteriorated 230 kV cables of Circuits 2L39 and 2L40, installed in 1957, between Newell Substation and the Hill Avenue Terminal Station.

SECTION B - TRANSMISSION REQUIREMENTS

Overhead Lines

In order to re-terminate the 230 kV overhead transmission lines at the new Hill Avenue Terminal Station, a minor reconfiguration of one span of each overhead line will be required.

Underground Cables

Route

The underground cable sections of Circuits 2L39 and 2L40 are each approximately 3.3 kilometres in length and run from Newell Substation, located at Kingsway and Griffiths in Burnaby to the Hill Avenue Terminal Station, located east of Hill Avenue, between the Trans Canada Highway and Burnaby Lake. The two cable circuits are installed in concrete ductbanks, which run in parallel for most of the route, except in the vicinity of Newell Substation. The routes are relatively straight with a few bends.

The cable circuits leave Newell Substation, located at an elevation of 121 metres above geodetic datum and gradually rise to an elevation of 126 metres, in about a 400 metre horizontal distance. The cables then descend slowly to an elevation of 107 metres in about a 1440 metres horizontal distance and then descend steeply to an elevation of 17 metres, in about a 1400m horizontal distance, to reach the Hill Avenue Terminal Station. The maximum elevation change between the highest and lowest point is approximately 109 metres.

Civil and Auxiliary Facilities

The new cables will be installed in the existing duct banks, except for the crossing of the Trans Canada Highway where the new ducts will be installed by the horizontal directional drilling method.

The duct bank of each circuit consists of a square formation, comprising four 125 mm (inside diameter) asbestos-cement ducts (3 cables and 1 spare) encased in concrete, with 20cm centre to centre spacing between the ducts. The outside dimensions of the duct bank are 50 cm x 50 cm.

Some sections of the ducts may require repairs to reduce offsets at the duct joints, which could interfere with the installation of the new cables. The extent of the repairs will vary based on the diameter of the new cables, which will depend on the cable manufacturer.

There are presently 16 manholes installed for each circuit with the maximum distance between two manholes of 207m. The size of the manholes is 8.5 metres long, 2.1 metres wide and 2.1 metres high. It is planned to pull the cables through many of the manholes to minimize the number of cable joints. The final number of joints will depend mainly on the maximum cable shipping lengths. Some of the existing manholes may need to be enlarged to fit the new cable joints.

In the steep terrain section towards the Hill Avenue Terminal Station, cable anchors will be installed to prevent downward migration of cables, due to circuit load cycling forces or seismic shaking.

A set of oil stop joints, oil reservoirs and an oil containment facility will be installed for each circuit in a new manhole in the section south of the Trans Canada Highway. This will help to reduce oil pressures due to the relatively high elevation difference between the highest and lowest points along the route.

Cables

The existing cables are Self-Contained Oil-Filled (SCOF) cables. The cables are under a constant oil pressure, which is maintained by an oil-pumping system and oil reservoir at Newell Substation.

The new cables will be the Self-Contained Oil-Filled (SCOF) type, similar to the above, with an aluminum sheath, either with Kraft Paper insulation or Polypropylene Laminated Paper (PPLP) insulation. Figure 1 shows a typical cross-section of this type of cable. The overall diameter of the cables will be approximately 100 to 110 mm, depending on the specific cable construction and manufacturer.

In order to meet long-term load requirements the cables will be designed to meet the ampacity criteria shown below. The actual ampacity may vary somewhat depending on the cable type and manufacturer. For comparison purposes the ratings of the existing cables are also provided.

TABLE - A

	Existing Cables	New Cables
Normal Maximum	680A	1050A
Emergency 200 Hrs	800A	1350A

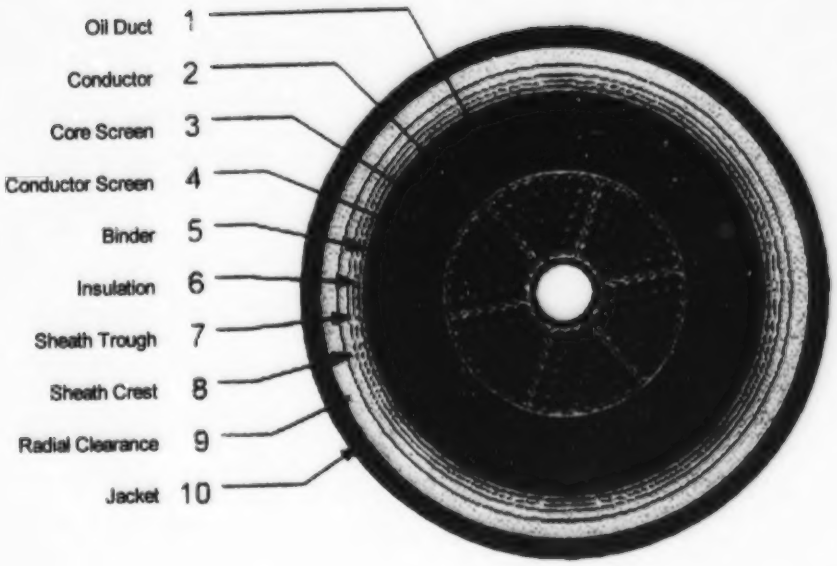


Figure 1 - Typical Cross-Section of 230kV Self-Contained Oil-Filled Cable

SECTION C – STATION REQUIREMENTS

The following work will be undertaken at Newell Substation and the Hill Avenue Terminal Station:

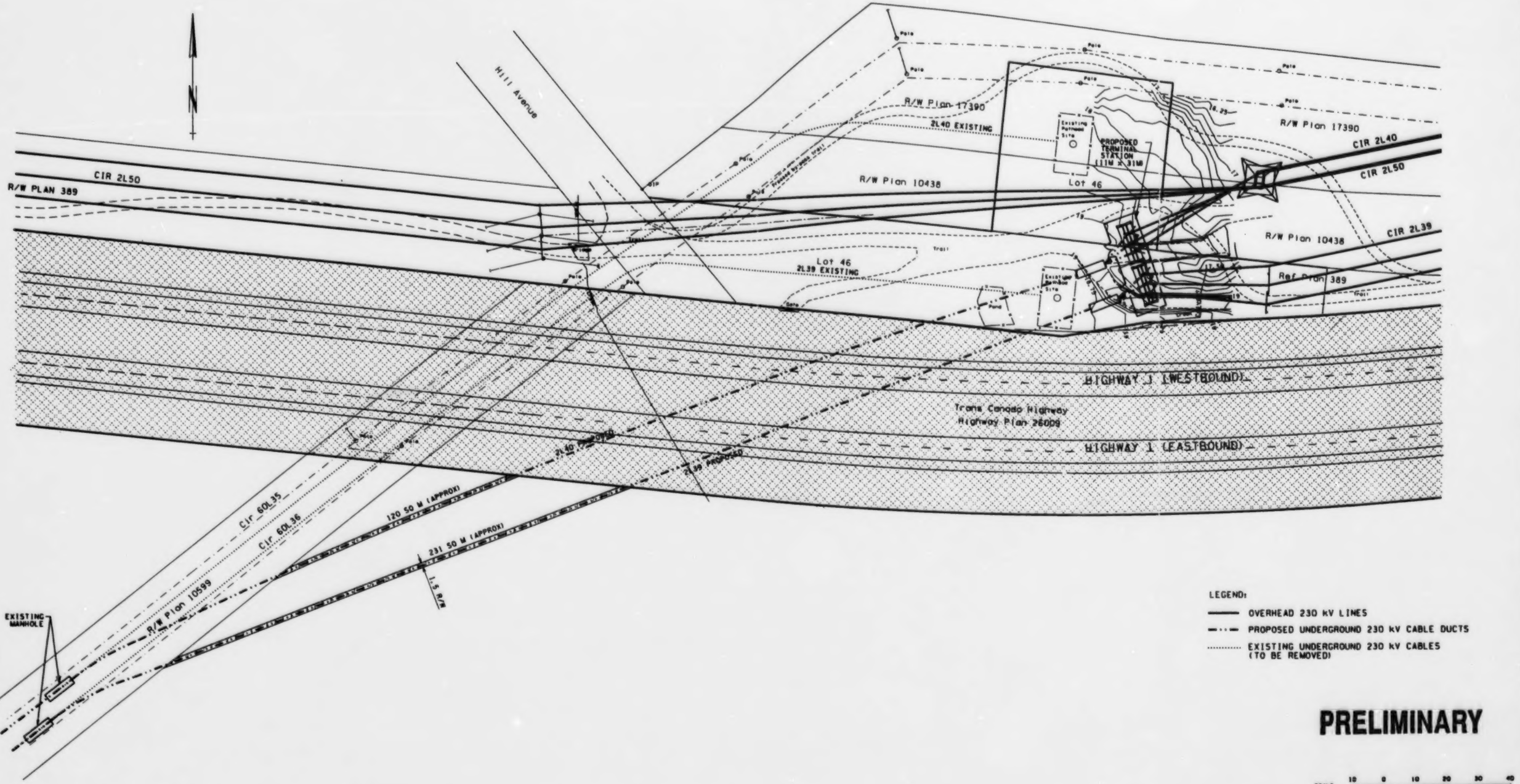
Newell Substation

- Installation of new terminations, supporting structures and foundations.
- Installation of new oil supply system and containment facilities.
- Removal of existing terminations, supporting structures and foundations.
- Removal of existing oil supply system

Hill Avenue Terminal Station

- Upgrading of site access.
- Seismic ground improvement of the new terminal station site.
- Installation of new ducts under the Trans Canada Highway, by horizontal directional drilling.
- Installation of new terminal station including new terminations, supporting structures and foundations.
- Rearrangement of overhead transmission line connections.
- Installation of new oil containment facilities.
- Removal of existing terminal stations including terminations, supporting structures and foundations.

The location of the new Hill Avenue Terminal Station is shown on Drawing 440B-E05-D1. The evaluation of the alternatives for the new Hill Avenue Terminal Station is summarized in the attached supporting document titled "Circuit 2L39 and 2L40 Underground Cable Replacement between Hill Avenue Terminal Station and Newell Substation, Environmental Planning and Assessment Report", B.C. Hydro, March 2000.



LEGEND:

- OVERHEAD 230 kV LINES
- PROPOSED UNDERGROUND 230 kV CABLE DUCTS
- EXISTING UNDERGROUND 230 kV CABLES (TO BE REMOVED)

PRELIMINARY

SCALE 1:800 — 10 0 10 20 30 40 METRES

BCHydro

HILL AVENUE TERMINAL STATION

SITE PLAN

DRN
CHKD
DFTG MJH
DFTG CHK
CHKD
REV

SECTION D – EVALUATION OF CABLE TYPES

In order to identify the potential cable types which could be installed in the existing ducts and meet the long term load requirements, an in depth review was conducted by B.C. Hydro. This review included a survey of cable manufacturers and literature reviews.

The cable types considered were:

- Cross-linked polyethylene (XLPE) insulation cable with extruded aluminum sheath.
- XLPE insulation cable with metal laminated moisture barrier.
- Self-contained oil-filled (SCOF) cable with Kraft Paper insulation and extruded aluminum sheath.
- SCOF cable with Polypropylene Laminated Paper (PPLP) insulation and extruded aluminum sheath.

The evaluation was based on the following key criteria:

- Use of existing ductbanks and manholes.
- Cables designed and rated for approximately 40 years of load growth.
- Proven short and long-term reliability.
- Low maintenance and quick repairability.
- Acceptable environmental impact.
- Low lifecycle costs.

The key findings of the evaluation were:

XLPE Cables

- XLPE 230 kV cables with prefabricated joints have only been in operation for 4-5 years and therefore do not have long-term field proven operating experience.
- Properly designed and manufactured XLPE cables are generally reliable and most of the failures occur within 1-2 years of installation and can be attributed to poor joint workmanship.
- XLPE cables offer oil-less construction and minimum maintenance.
- XLPE cables with an extruded aluminum sheath, designed to meet the required ampacity, would not fit into the existing ducts.
- There is limited knowledge on the long-term performance of XLPE cables with metal laminated moisture barrier (only 0.2mm thick) and there are no industry-accepted methods for testing its effectiveness. Exclusion of moisture from the cable insulation is extremely important for long-term reliable performance of the cables.

SCOF Cables

- Self-contained oil-filled cables have long-term field proven operating experience (over 45 years for Kraft Paper insulation cables and 18 years for PPLP cables).
- Oil supply and containment facilities are required.
- Cables have an extruded anti-corrosion protective covering over the aluminum sheath; therefore, the risk of oil leaks, due to corrosion is minimal.
- In comparison with XLPE cable of similar ampacity, oil-filled cables have a smaller diameter and are more suitable for installation in existing ducts.

Conclusion

As neither of the evaluated XLPE cable types met all of the key criteria, the tender for the supply/install contract will be limited to self-contained oil-filled type cables only.

SECTION E - SCHEDULE

The two 230 kV cable circuits, 2L39 and 2L40, between Newell Substation and the Hill Avenue Terminal Station, are scheduled for replacement by 2002. The replacement is planned to be done in two stages.

The construction of the new Hill Avenue Terminal Station and all civil and cable replacement work for Circuit 2L39 is scheduled to be carried out in the first stage in 2001. The balance of the civil and cable replacement work for Circuit 2L40 will be carried out in the second stage in 2002.

Figure 2 shows the key activities associated with this project.

ID	Task Description
1	Hill Avenue Terminal Station and Access Assessment
2	Initial Consultation
3	Project Plan and Business Case
4	BC Hydro Board Approval
5	Preliminary Design
6	CPCN Application
7	Public Consultation
8	BCUC Review
9	BCUC Order Issued
10	**Upgrade of Access to Hill Avenue Terminal Station**
11	Tender Call
12	Tender Close
13	Tender Award
14	Construction
15	**Cable Supply/Install Contract**
16	Tender Call
17	Tender Close
18	Tender Award
19	**Stage 1-Circuit 2L39 & Hill Avenue Terminal Station**
20	Hill Avenue Terminal Station Construction
21	Cable Manufacture and Delivery
22	Installation
23	Circuit 2L39 Re-Energized
24	**Stage 2-Circuit 2L40**
25	Cable Manufacture and Delivery
26	Installation
27	Circuit 2L40 Re-Energized

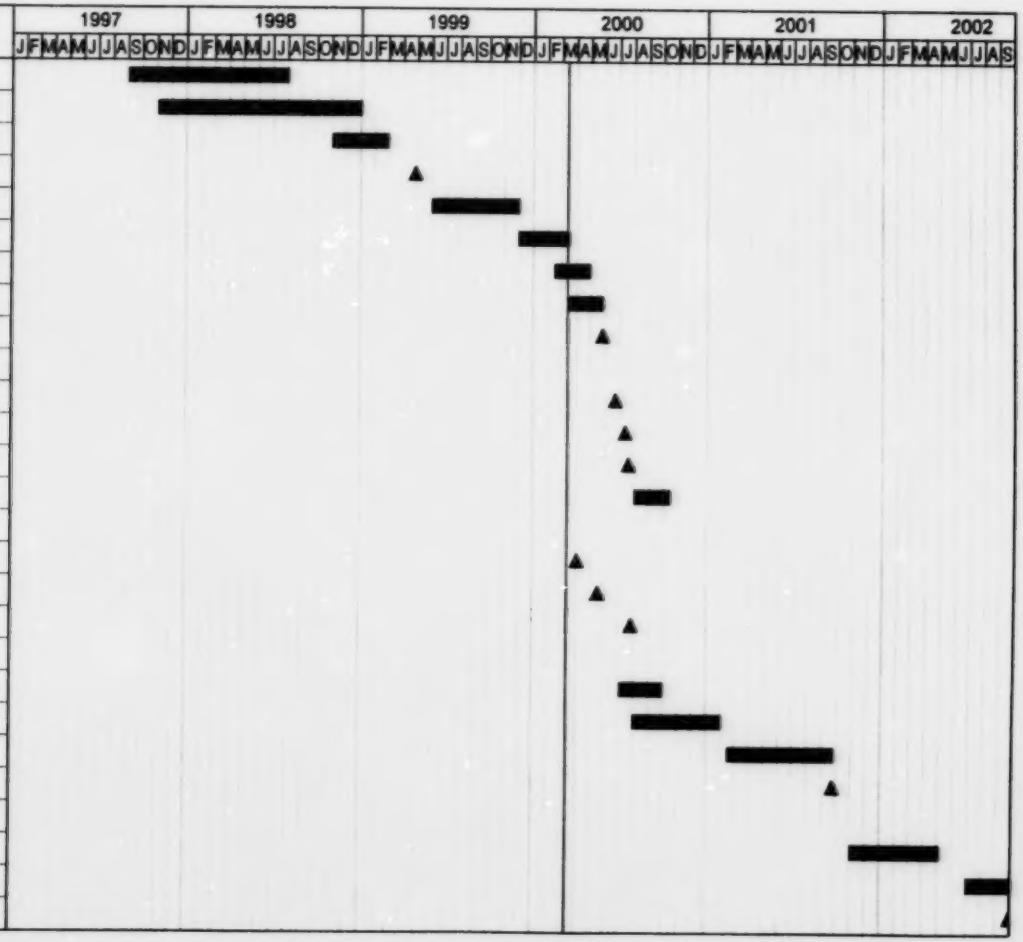


Figure 2 - Project Schedule

SECTION F – RIGHT-OF-WAY

F.1 EXISTING RIGHT-OF-WAY

The 2L39 and 2L40 cable circuits are located mainly within an 24.4 metre (80') wide right of way corridor between Newell Substation, located at Kingsway and Griffiths Avenue, Burnaby, and the Hill Avenue Terminal Station, located between the Trans Canada Highway and Burnaby Lake. The right-of-way corridor consists of B.C. Hydro fee owned property and a B.C. Hydro easement located within the City of Burnaby. The right of way corridor is located primarily within a single-family residential community, with some low-level wood frame apartment dwellings, near Kingsway. The Hill Avenue Terminal Station is located on B.C. Hydro fee owned property and on a B.C. Hydro easement located on Federal Government land leased to the Greater Vancouver Regional District (GVRD). Newell Substation is located on B.C. Hydro fee owned property. The right-of-way corridor encumbers 33 private parcels including one school (Lakeview Elementary School).

B.C. Hydro is currently negotiating with one property owner, immediately north-east of Canada Way, to re-establish the underground rights (originally acquired in 1957) which were accidentally dropped by the BC Land Title Office during sub-division of the subject property.

F.2 ADDITIONAL RIGHT-OF-WAY REQUIREMENTS

An underground easement across Robert Burnaby Park will be required for the new ducts that will be installed by horizontal directional drilling under the Trans Canada Highway. The location of the easement is shown on Drawing 440B-E05-D1. B.C. Hydro will restrict the easement requirements to a minimum and the final area will be determined once the ducts are installed. The proposed ducts will be installed at a depth of about 10-15 metres below the surface and no adverse impacts on the existing park vegetation are anticipated. The City of Burnaby has been consulted in this regard and has advised B.C. Hydro that there is no impediment to granting the additional right-of-way to B.C. Hydro. Once the easement details are finalized, an application will be submitted to the City's Parks and Recreation Commission and Council.

SECTION G – ACCESS

G.1 UPGRADING OF EXISTING ACCESS TO HILL AVENUE TERMINAL STATION

The attached access plan as shown on Drawing No. 400-T07-B366 (Sheets 1-4) describes the access to the site. Access will utilize, as much as possible, the trail already in place.

The upgraded access road will follow the existing hog fuel trail, located within the B.C. Hydro right-of-way. The access road will be upgraded over its entire length by installing geo-textile filter fabric on top of the existing hog fuel then placing a 30 cm surface course of pit run gravel. This will make it a 4 metre wide gravel roadway.

The existing culverts will be upgraded as specified on the access plan and the work will be completed in accordance with the Department of Fisheries and Oceans (DFO) and the Ministry of Transportation and Highways (MOELP) permits.

B.C. Hydro will arrange for an independent engineering assessment of the municipal roads, specifically Sperling Avenue and Glencarin Drive, along the proposed access route before and after construction. Any resulting damage, attributable to B.C. Hydro's construction activities, will be repaired to the satisfaction of the City of Burnaby. B.C. Hydro will also work with the City of Burnaby staff on the traffic plan through the Burnaby Lake Sport Complex facilities to ensure that construction impacts are minimized. Prior to construction commencing a public notification program will be undertaken.

Although access to the Hill Avenue Terminal Station directly off the Trans Canada Highway would be the preferable option to B.C. Hydro, it is recognized that such access would cause significant disruption to the highway traffic. Extensive discussions were held with the Ministry of Transportation and Highways (MOTH) and an agreement was reached to allow for limited off-peak night access, for the heaviest equipment to remain on site for extended duration's.

G.2 ACCESS ALONG THE CABLE ROUTE, HILL AVENUE TERMINAL STATION TO NEWELL SUBSTATION

The proposed access is shown on Drawing 2L39-V07-B21 (Sheets 1-4). The amount of access preparation along the existing route is minimal. Prior to the commencement of construction, the plan will be updated with input from affected property owners and the City of Burnaby.

In the Robert Burnaby Park area, south of the Trans Canada Highway, B.C. Hydro will work with the City of Burnaby to determine the best location of temporary trails so that impacts on the park users are minimized. In order to ensure site safety, proper signage and safety fences will be installed by B.C. Hydro in the trail area.

B.C. HYDRO TO CONDUCT ROAD CONDITION ASSESSMENT
(Sperling Ave from Sprott St. and Glencairn Dr.)

TO HILL AVE TERMINAL

Sperling Ave

Sprott St

Kensington Ave

GOWRIE ST.

GLENCAIRN DR.

MATCH LINE

SK. 3026

HIGHWAY #1

VANCOUVER

2L50

15

16

14

LEGEND

- UNDERGROUND UTILITY
- DITCH
- OVERHEAD UTILITY
- CULVERT
- PROPOSED POLE
- EXISTING WOOD POLE
- EXISTING TOWER
- (4) STRUCTURE NUMBER
- 2m CREEK

METRES 0 100 200

SCALE 1:2500

No.	REVISIONS	MADE	CKD	INSP	INSP	DATE

FUNCTIONAL CODE 2.07

BChydro
SURVEY AND PHOTOGRAMMETRY DEPARTMENT

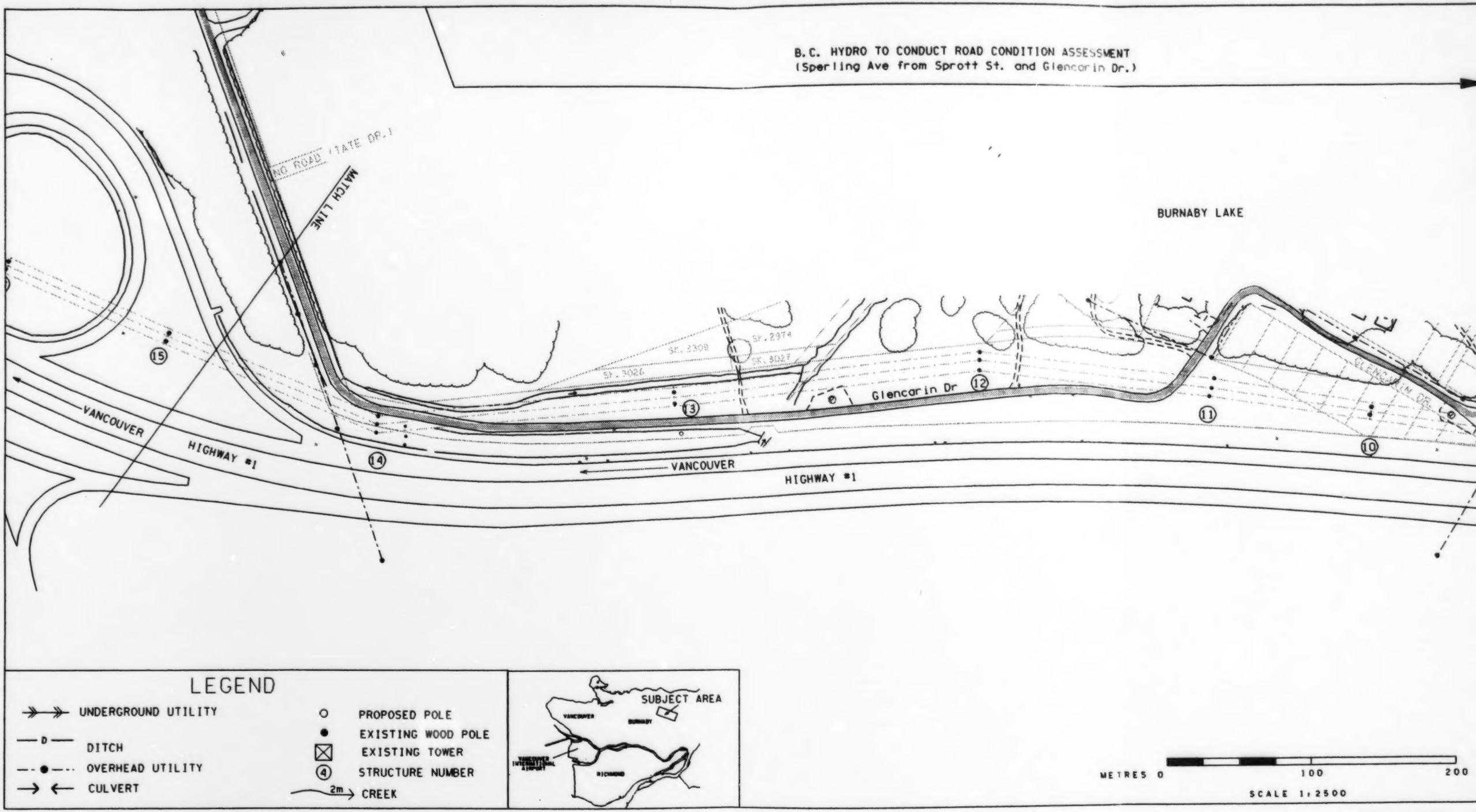
HILL AVE TERMINAL STATION
CIRCUITS 2L39/40
CABLE REPLACEMENT PROJECT
ACCESS ROAD WITHIN CIRCUIT 2L50 R/W
ACCESS PLAN SHEET 1 OF 4

CHECKED	
INSPECTED	
DATE	
GRID ORIGIN	UTM Z10/NAD83
N.T.S.	
PROJECT No.	
PHOTO DATE	
PHOTO SCALE	
DATUM	GEODETIC
DWG. SCALE	1:2500
CONTOUR INT.	
DWG. No.	400-T07-B366
No.	0

DIGITAL MAP

TAL													
RING	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR	LL	NO.	REVISIONS	MADE	CKD	APPD	DATE
AREA (ha)		REVISIONS										

B.C. HYDRO TO CONDUCT ROAD CONDITION ASSESSMENT
(Sperling Ave from Sprott St. and Glencarin Dr.)



LEGEND

- UNDERGROUND UTILITY
- DITCH
- OVERHEAD UTILITY
- CULVERT
- PROPOSED POLE
- EXISTING WOOD POLE
- EXISTING TOWER
- (4) STRUCTURE NUMBER
- 2m CREEK

METRES 0 100 200

SCALE 1:2500

TAL													
RING	STANDARD												
AREA (Ha.)		BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR	LL	NO.	REVISIONS	MADE	CKD	APPD	DATE	

DIGITAL MAP

No.	REVISIONS	MADE	CHKD	INSP	INSP	DATE	FUNCTIONAL CODE 2.07
CHECKED	PROJECT No.	BChydro SURVEY and PHOTOGRAMMETRY DEPARTMENT					
INSPECTED	PHOTO DATE	HILL AVE TERMINAL STATION					
DATE	PHOTO SCALE	CIRCUITS 2L39/40					
GRID ORIGIN UTM 710/NAD83	DATUM GEODETIC	CABLE REPLACEMENT PROJECT					
N.T.S.	DRG. SCALE 1:2500	ACCESS ROAD WITHIN CIRCUIT 2L50 R/W					
	CONTOUR INT.	ACCESS PLAN SHEET 2 OF 4					
		DRG. No. 400-T07-B366					

INSTALL FILTER FABRIC AND PLACE GRAVEL OVER TO 300mm

CULVERT #1
LEAVE IN PLACE
ADD 1.5m EXTENSION TO BOTH ENDS
CLEAN OUT BOTH ENDS

BURNABY LAKE

CULVERT #2
REMOVE 2 'O' CULVERTS
INSTALL 1 'D' CULVERT
RAISE ROAD LEVEL

CULVERT #3
REMOVE POLY 'O' CULVERT
INSTALL 'O' CULVERT 10m WEST
DITCH 10m EACH SIDE OF SOUTH
END OF DRAINAGE

CULVERT #4
REMOVE 'O' CULVERT
INSTALL 'D' CULVERT (9m)
REALIGN NORTH END 1m WEST

CULVERT #4A
WOODSTAVE CULVERT (13m)
LEAVE AS IS

CULVERT #4B
INSTALL 'O' CULVERT
FOR DRAINAGE

MATCH LINE

CULVERT #5
REMOVE 'O'
INSTALL 'D

9 LOCKED GATE

8

7

6

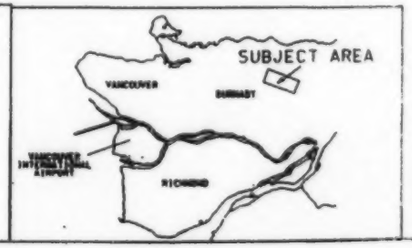
5

VANCOUVER HIGHWAY #1

GUY ANCHORS

LEGEND

- UNDERGROUND UTILITY
- D — DITCH
- OVERHEAD UTILITY
- CULVERT
- PROPOSED POLE
- EXISTING WOOD POLE
- EXISTING TOWER
- (4) STRUCTURE NUMBER
- 2m CREEK



METRES 0 100 200

SCALE 1:2500

TOTAL																
CLEARING	STANDARD					BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR	LL	NO.	REVISIONS	MADE	CKD	APPD	DATE
AREA (ha)						REVISIONS										

NO.	REVISIONS	MADE	CHKD	INSP	INSP	DATE

FUNCTIONAL CODE 2.0T

CHECKED | PROJECT No.

INSPECTED | PHOTO DATE

DATE | PHOTO SCALE

GRID ORIGIN UTM Z10/NAD83 | DATUM GEODETIC

N.T.S. | DWG. SCALE 1:2500 | CONTOUR INT.

BChydro
SURVEY AND PHOTOGRAMMETRY DEPARTMENT

HILL AVE TERMINAL STATION
CIRCUITS 2L39/40
CABLE REPLACEMENT PROJECT
ACCESS ROAD WITHIN CIRCUIT 2L50 R/W
ACCESS PLAN SHEET 3 OF 4

DWG. No. 400-T07-B366 | R. 0

DIGITAL MAP

INSTALL FILTER FABRIC AND PLACE GRAVEL OVER TO 300mm

LEVEL NEW TERMINAL SITE
INSTALL 40X40 FILTER
FABRIC AND PLACE 300mm
OVER GRADE

MATCH LINE

CULVERT #5
REMOVE 'O' CULVERT
INSTALL 'D' CULVERT (10m)

CULVERT #6
LEAVE IN PLACE
ADD 2m EXTENSIONS
TO BOTH ENDS

CULVERT #8
REMOVE 'O' CULVERT
INSTALL 'D' CULVERT (10m min)
WEIRS UPSTREAM OR DOWNSTREAM.

EXISTING TERMINALS

INSTALL GVRD WATERMAIN
CROSSING FACILITY

INSTALL BYPASS TRAIL
(USE BARK FROM EXISTING TRAIL)

BURNABY LAKE

HILL AVE.

GVRD WATERMAIN

60L35
60L36
2L40
2L50
2L39

2L50

REF. 350

4
3
2
1
3B
3B

VANCOUVER

HIGHWAY #1

CULVERT #9 AND #9A
REMOVE 2 'O' CULVERTS
INSTALL 'O' CULVERT (35m)
UNDER NEW STATION WORKSITE

PROPOSED TERMINAL
STATION

ACCESS FROM HWY #1
LIMITED TO OFF PEAK HOURS

CULVERT #7
REMOVE WOODSTAVE CULVERT
INSTALL 'D' CULVERT (11m)
REALIGN SOUTH END 1.5m EAST

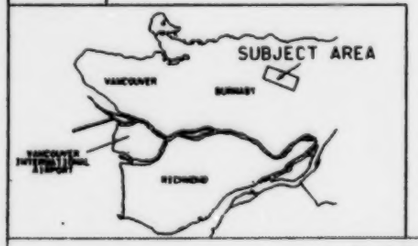
PROPOSED CABLE ALIGNMENTS

ROBERT BURNABY CREEK

ROBERT BURNABY PARK

ROBERT BURNABY PARK

SEE DWG. NO. 2L39-V07-B21



LEGEND

- UNDERGROUND UTILITY
- DITCH
- OVERHEAD UTILITY
- CULVERT
- PROPOSED POLE
- EXISTING WOOD POLE
- EXISTING TOWER
- (4) STRUCTURE NUMBER
- 2m CREEK

METRES 0 100 200

SCALE 1:2500

TOTAL CLEARING	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR

NO.	REVISIONS	MADE	CKD	APPD	DATE

DIGITAL MAP

NO.	REVISIONS	MADE	CHKD	INSP	PREP	DATE
CHECKED	PROJECT No.	BChydro SURVEY and PHOTOGRAMMETRY DEPARTMENT				FUNCTIONAL CODE 2.07
INSPECTED	PHOTO DATE	HILL AVE. TERMINAL STATION				
DATE	PHOTO SCALE	CIRCUITS 2L39/40				
GRID ORIGIN UTM Z10/NAD83	DATUM GEODETIC	CABLE REPLACEMENT PROJECT				
N.T.S.	ORIG. SCALE 1:2500	ACCESS ROAD WITHIN CIRCUIT 2L50 R/W				
	CONTOUR INT.	ACCESS PLAN SHEET 4 OF 4				
	ORIG. No. 400-107-B366					

EXISTING VEHICLE ACCESS ALONG RIGHT-OF-WAY
VIA LAKEFIELD DR. ENTRANCES ONLY

Robert Burnaby Park

LOCKED CABLE GATES

GB

GA

FZ

FY

600

400

400

GQ

GP

GC

Lakefield Dr

Robert Burnaby Park

PROPOSED CABLE ALIGNMENTS

EXISTING TERMINAL

60L35

60L36

2L40

2L50

2L39

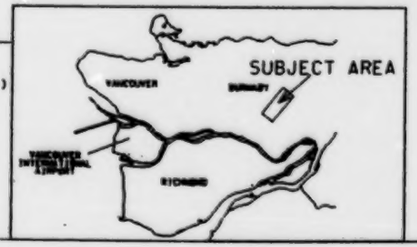
PROPOSED TERMINAL

ROBERT BURNABY CREEK

HAZARD TREE
REMOVAL REQUIRED
ON SE SIDE OF RIGHT-OF-WAY

LEGEND

- FOOT PATH
- UNDERGROUND CABLE VAULT WITH TWO MANHOLE ACCESS
- GQ — VAULT IDENTIFICATION
- EXISTING WOOD POLE
- 400 — CULVERT (400mm DIA.)
- EXISTING TOWER



METRES 0 100 200

SCALE 1:2500

TOTAL CLEARING AREA (ha)	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR
		REVISIONS			

LL	NO.	REVISIONS	MADE	CKD	APPD	DATE

									FUNCTIONAL CODE 2.07
No.	REVISIONS		MADE	CHKD	3rdP	2ndP	DATE		
CHECKED	PROJECT No.	BChydro SURVEY and PHOTOGRAMMETRY DEPARTMENT							
INSPECTED	PHOTO DATE	HILL AVE. - NEWELL 230kV CIRCUITS 2L39/40 CABLE REPLACEMENT PROJECT ACCESS PLAN							
DATE	PHOTO SCALE								
GRID PROJECTION UTM Z10/NAD83	DATUM GEODETIC	SHEET 1 OF 4							
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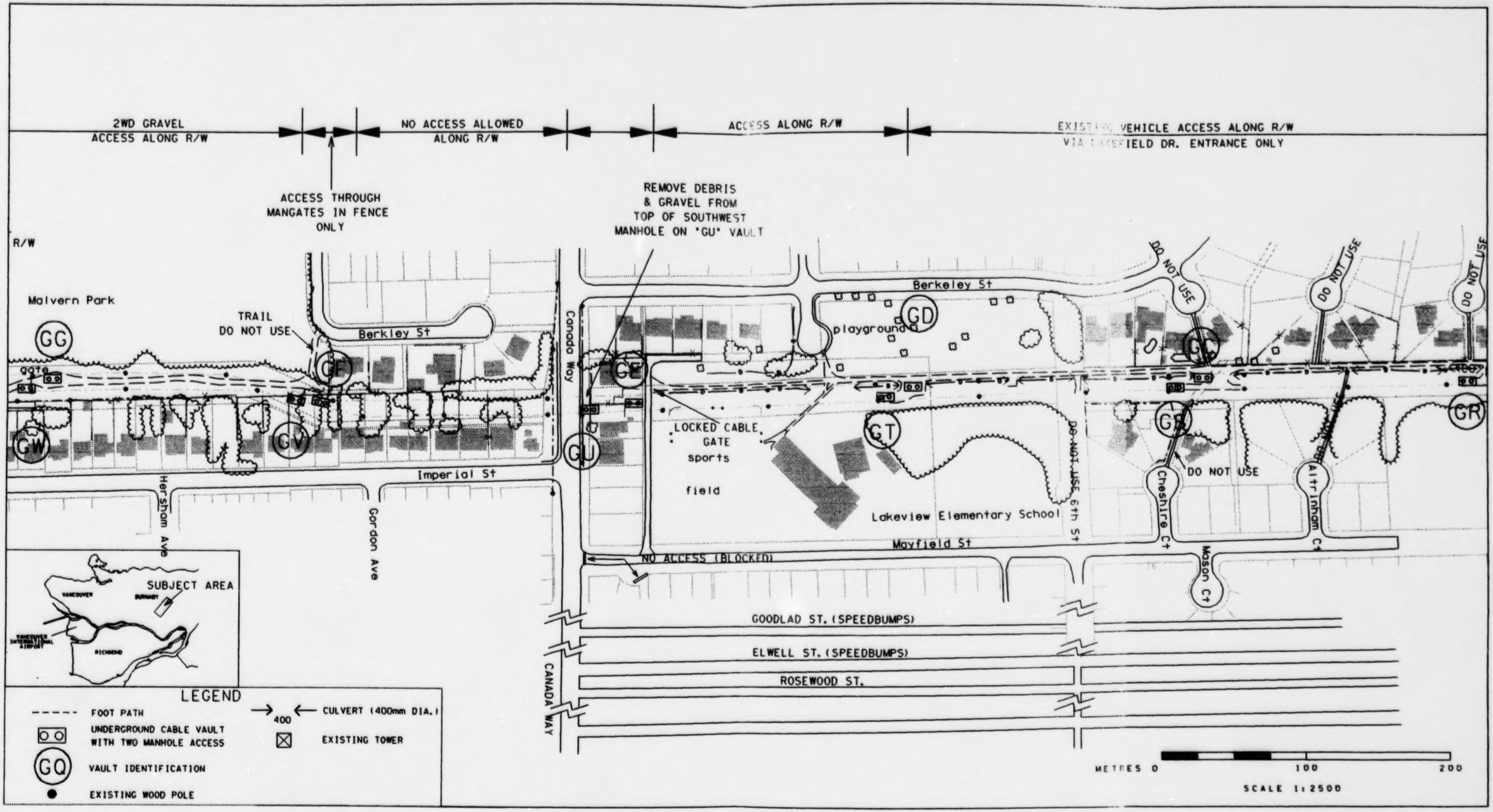
DIGITAL MAP



No.	REVISIONS	MADE	CHKD	INSP	INSP	DATE	FUNCTIONAL CODE 2.07

BChydro
SURVEY and PHOTOGRAMMETRY DEPARTMENT

CHECKED | PROJECT No.
INSPECTED | PHOTO DATE
DATE | PHOTO SCALE
GRID ORIGIN UTM Z10/NAD83 | DATUM GEODETIC
N.T.S. | ORIG. SCALE 1:2500
DIGITAL MAP

HILL AVE. - NEWELL 230kV
CIRCUITS 2L39/40
CABLE REPLACEMENT PROJECT
ACCESS PLAN

SHEET 2 OF 4
CONTOUR INT. | DWG. No. 2L39-V07-B21 | R. 0

TOTAL CLEARING	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR	LI	NO.	REVISIONS	MADE	CKD	APPD	DATE
AREA (ha)		REVISIONS										

EXISTING VEHICLE ACCESS TO MANHOLES ON R/W

2WD GRAVEL ACCESS ALONG

MATCH LINE

Malvern Park

IMPERIAL STREET

Walker Ave

Liddy Ave

Malvern Ave

Buford St

Griffiths Ave

Halligan St

Imperial St

McBride St

Salisbury Ave

Linden Ave

Fulton Ave

Strathmore Ave

Humphries Ave

Acacia Ave

GH GI GJ GK GL HB HC

60L35 60L36 600 300 1m

LEGEND

- FOOT PATH
- UNDERGROUND CABLE VAULT WITH TWO MANHOLE ACCESS
- GQ VAULT IDENTIFICATION
- EXISTING WOOD POLE
- → 400 ← CULVERT (400mm DIA.)
- EXISTING TOWER

SUBJECT AREA

METRES 0 100 200

SCALE 1:2500

TOTAL AREA (ha)	BEARING	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR

REVISIONS

LI	NO.	REVISIONS	MADE	CKD	APPD	DATE

NO.	REVISIONS	MADE	CKD	APPD	DATE	FUNCTIONAL CODE 2.07

BCHydro
SURVEY and PHOTOGRAMMETRY DEPARTMENT

HILL AVE. - NEWELL 230kV
CIRCUITS 2L39/40
CABLE REPLACEMENT PROJECT
ACCESS PLAN
SHEET 3 OF 4

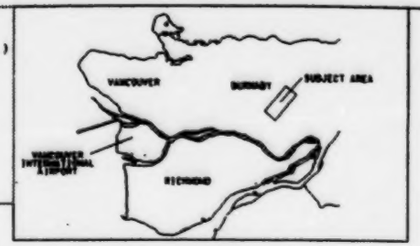
CHECKED	PROJECT No.	
INSPECTED	PHOTO DATE	
DATE	PHOTO SCALE	
GRID DATUM UTM 710/NAD83	DATUM GEODETIC	DRG. SCALE 1:2500

CUSTOM DEV. DRG. No. 2L39-V07-B21 R. 0

DIGITAL MAP

LEGEND

- FOOT PATH
- UNDERGROUND CABLE VAULT WITH TWO MANHOLE ACCESS
- GQ — VAULT IDENTIFICATION
- EXISTING WOOD POLE
- 400 — CULVERT (400mm DIA.)
- EXISTING TOWER



METRES 0 100 200

SCALE 1:2500

EXISTING VEHICLE ACCESS TO MANHOLES ON R/W

Sperling Ave

Beresford St

60L35

60L36

60L36

NEWELL SUBSTATION

Kingsway

GN

Arcola St

2L40

GM

Balmoral St

Imperial St

MATCH LINE

Griffiths Ave

HX

2L39

HC

GL

HB

Griffiths Ave

Halligan St

McBride St

Buford St

ACCESS THROUGH STATION	EXISTING VEHICLE ACCESS TO MANHOLES ON GRIFFITHS AVE.

TOTAL CLEARING	STANDARD	BUILD MAIN ROAD	BUILD VEHICLE TRACK	RE-GRADE	INSTALL WATER-BAR	LL	NO.	REVISIONS	MADE	CKD	APPD	DATE

NO.	REVISIONS	MADE	CHKD	2ndP	3rdP	DATE	FUNCTIONAL CODE 2.07
CHECKED	PROJECT No.	BChydro SURVEY and PHOTOGRAMMETRY DEPARTMENT					
INSPECTED	PHOTO DATE	HILL AVE. - NEWELL 230kV CIRCUITS 2L39/40 CABLE REPLACEMENT PROJECT ACCESS PLAN					
DATE	PHOTO SCALE						
GRID ORIGIN UTM Z10/NAD83	DATUM GEODETIC	SHEET 4 OF 4					
M.T.S.	DWG. SCALE 1:2500	CONTOUR INT.	DWG. No. 2L39-V07-B21				NO. 0

SECTION H – ELECTRIC AND MAGNETIC FIELDS

B.C. Hydro retained Paul Wong International Inc. to undertake an analysis of the magnetic field levels along the cable route and those resulting from the proposed cable replacement project. The analysis considered both the existing 230 kV and 69 kV circuits between Newell Substation and the Hill Avenue Terminal Station.

Three locations along the existing cable route, with typical underground and overhead line configurations, were selected for the study. The magnetic field calculation method was first verified using data collected from the existing 230 and 69 kV circuits. Then it was used to predict field levels from the existing 69 kV circuits with either the existing or new 230 kV cables, for both balanced average and peak load conditions.

EVALUATION SITES

Location 1: The site is located at the intersection of Griffiths Avenue and Balmoral Street in Burnaby. The site comprises an existing underground 230 kV cable ductbank (Circuit 2L39). The location was selected to represent all sites along the cable route where there is only one 230 kV cable and no overhead 69 kV lines. As the cable is installed under a public road, there is no right-of-way and the property lines of the two closest properties represent the right-of-way edge.

Location 2: The site is located on the 230 and 69 kV right-of-way located between Balmoral Street and the lane to the north of Balmoral Street in Burnaby. The site comprises two overhead 69 kV lines (Circuits 60L35 and 60L36) and one underground 230 kV cable ductbank (Circuit 2L40). The location was selected to represent all sites along the cable route where there are two overhead 69 kV lines and one underground 230 kV cable ductbank.

Location 3: The site is located on the 230 and 69 kV right-of-way, in the lane between Lakeview Elementary School and Canada Way in Burnaby. The site comprises two overhead 69 kV lines (Circuits 60L35 and 60L36) and two underground 230 kV cable ductbanks (Circuits 2L39 and 2L40). The location was selected to represent all sites along the cable route where there are two overhead 69 kV lines and two underground 230 kV cable ductbanks.

SUMMARY RESULTS

The calculated maximum magnetic field levels are summarized in Table 1 below. The calculations assume that the currents are equal in each phase of each line and are therefore balanced.

For normal balanced average load, the maximum field levels with the existing cables for Locations 1 to 3 in Year 2000 are about 5.0 mG at the edge of the right-of-way (or property line for Location 1), dropping rapidly to 2.0 and 0.5 mG respectively at 10 and 30 metres from the edge of the right-of-way. The corresponding maximum levels with the new cables will be about 5.3, 2.1 and 0.6 mG respectively in Year 2002, and about 10.3, 4.3 and 1.2 mG respectively in Year 2042. The change in field levels from the Year 2000 to Year 2042 will be no more than 5.3, 2.4 and 0.7 mG respectively at 0, 10 and 30 metres from the edge of the right-of-way.

For balanced peak load, the maximum field levels with the existing cables for Locations 1 to 3 in Year 2000 are about 7.4 mG at the edge of the right-of-way dropping rapidly to 2.7 and 0.7 mG respectively at 10 and 30 metres from the edge of the right-of-way. The corresponding maximum levels with the new cables will be 8.1, 3.0 and 0.8 mG respectively in Year 2002, and about 15.9, 6.2 and 1.6 mG respectively in Year 2042. The change in field levels from Year 2000 to Year 2042 will be no more than 8.5, 3.5 and 0.9 mG respectively at 0, 10 and 30 metres from the edge of the right-of-way.

Table 1 - SUMMARY OF CALCULATED MAXIMUM MAGNETIC FIELD LEVELS

Distance away from edge of right-of-way or property line (m)	With existing cables (mG)	With new cables (mG)		Largest change in field levels (mG)	Largest change in field levels (mG)
	Y2000	Y2002	Y2042	Y2002	Y2042
Balanced average load: Within ROW	38.0	39.2	62.3	1.3	24.4
0	5.0	5.3	10.3	0.3	5.3
10	2.0	2.1	4.3	0.1	2.4
20	0.9	1.0	2.1	0.1	1.2
30	0.5	0.6	1.2	0.0	0.7
40	0.3	0.4	0.8	0.0	0.4
50	0.2	0.3	0.5	0.0	0.3
Balanced peak load: Within ROW	51.7	53.5	86.5	1.8	34.7
0	7.4	8.1	15.9	0.7	8.5
10	2.7	3.0	6.2	0.3	3.5
20	1.2	1.4	2.9	0.1	1.6
30	0.7	0.8	1.6	0.1	0.9
40	0.4	0.5	1.0	0.1	0.6
50	0.3	0.3	0.7	0.0	0.4

CONCLUSION

The magnetic fields measured and calculated for the present period are not significantly impacted by the replacement of the existing cables. Projected increases for Year 2042 reflect a normal load growth that will take place on many transmission circuits in B.C. Hydro's system.

The maximum magnetic field values, even for Year 2042, are well below the public exposure guideline recently proposed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in 1998.

Also recently published results of a major 10 year study of childhood leukaemia in the major metropolitan areas of Western Canada and Montreal, by a research team from the BC Cancer Agency and McGill University, found no connection between childhood leukaemia and magnetic fields, proximity of power lines or electric fields. This finding is consistent with the results of a series of animal cancer studies from around the world. Major animal studies in Canada, the USA, as well as other countries, have found no support for the concept that even extremely high magnetic fields can act as cancer initiators or promoters.